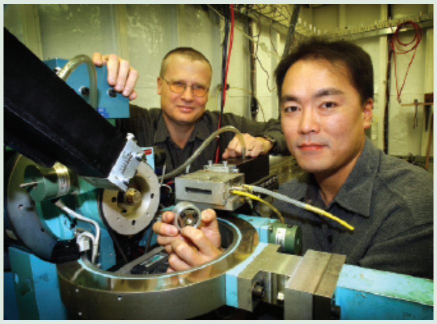
New Irreversible Expansion May Yield Better Pollution Trap

Scientists from Brookhaven National Laboratory and their collaborators have previously shown that certain zeolites — materials in which oxygen atoms are shared between tetrahedra-containing silicon and/or aluminium — can expand under pressure and take up more water to become superhydrated. These materials can exchange cations under pressure. Due to the pressure-induced expansion, larger molecules and cations — possibly pollutants — could be incorporated into the nano-sized pores of these "molecular sponges." When the pressure is released, the pollutants would become trapped.

However, in a reversible system, half of the water would be expelled again, making the sponges somewhat "leaky."

In a paper appearing in the December 5, 2002 issue of *Nature*, the scientists now describe a material that shows irreversible pressure-induced hydration. That is, when the pressure is released, the material stays superhydrated. This new finding opens up the possibility of using these "molecular sponges" to truly immobilize pollutants such as tritiated water.

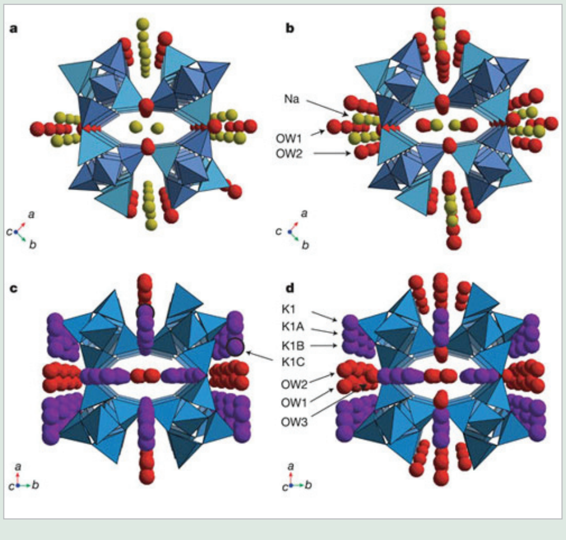


Physicist Tom Vogt (left) with postdoc Yongjae Lee at NSLS beamline X7A, where they determined the unusual structure of a new material that expands under pressure.

"Our studies show that the irreversible pressure-induced hydration is associated with a rearrangement of the charge-balancing cations contained in the nanopores," says Brookhaven physicist Thomas Vogt, a co-author on the previous research and the Nature paper. "By understanding these cation migrations and rearrangments under pressure, we hope to be able to reduce the pressure at which the pressure-induced hydration occurs, and thereby open up new ways to use zeolites as "molecular sponges" for pollutants or as transport vessels for medical applications."

The collaborators on this research include Vogt and Yongjae Lee of the Physics Department and Jonathan Hanson of the Chemistry Department at Brookhaven Lab; Joe Hriljac of the University of Birmingham, U.K.; John B. Parise of Stony Brook University; and Sun Jin Kim of the Korean Institute of Science & Technology. The research was funded by the U.S. Department of Energy, which supports basic research in a variety of scientific fields.

—Mona Rowe



Polyhedral representations of two forms of natrolite: sodium aluminosilicate (Na-AlSi-NAT) and potassium gallosilicate (K-GaSi-NAT) before and after pressure-induced hydration, (a) Na-AlSi-NAT at 0.40 gigapascals; (b) Na-AlSi-NAT at 1.51 gigapascals; (c) K-GaSi-NAT as synthesized; (d) K-GaSi-NAT recovered from 1.9 gigapascals. Tetrahedra in Na-AlSi-NAT are shown in light and dark blue to illustrate the ordering aluminum and silicon ions over the framework tetrahedral sites, whereas the gallium and silicon ions in K-GaSi-NAT are disordered and shown in one color. OW1, OW2 and OW3 are water sites; K1A, K1B, and K1C are potassium ion sites.